Ultrasound Receive Chain Demonstration Platform User's Guide

The Ultrasound Receive Chain Demonstration Platform was designed for ease of use in evaluating the VCA2615 and ADS5272 devices in an eight-channel beamforming application. This document provides the information needed to set up and operate the demonstration platform. For a more detailed description of the VCA2615 and the ADS5272, please refer to the product datasheets available from the Texas Instruments web site at http://www.ti.com. Additional support documents are listed in Section 1.1 and Section 1.2 of this guide. Throughout this document, the phrases *platform* and *demonstration platform* are synonymous. This user's guide includes setup and configuration instructions, information regarding operating procedures and input/output connections, an electrical schematic, printed circuit board (PCB) layout drawings, and a parts list for the demonstration platform.

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1 Introduction

The Ultrasound Receive Chain demonstration platform was designed to interface the VCA2615 variable gain amplifier with the ADS5272 low voltage differential signal (LVDS) output data converter. The CDCM7005 jitter cleaner provides the 65MHz clock to the ADS5272, although a bypass option is available. Additionally, an ADSDeSer-50EVM is necessary in order to convert the serial LVDS outputs of the ADS5272 to parallel data for a complete evaluation.

1.1 Related Documentation from Texas Instruments

The following documents provide information regarding Texas Instruments' integrated circuits used in the assembly of the demonstration platform. The latest revisions of these documents are available from the TI web site at http://www.ti.com.

Data Sheet	Literature Number
VCA2615 Datasheet	SBOS316
ADS5272 Datasheet	SBAS324
CDCM7005 Datasheet	SCAS793
ADS527xEVM User's Guide	SBAU094
ADSDeSer-50EVM User's Guide	SBAU091

1.2 Related Hardware

The following demonstration and evaluation tools are recommended for use with the platform. Information regarding these devices is available through the TI web site at http://www.ti.com.

Device Name	Device Number
8-Channel Serial LVDS Deserializer	SBAU091
ADS527x Xilinx Deserializer Solution	ADS527x-REF

2 Power Supplies

The demonstration platform requires three supplies:

- V_{DD} = 5V ±10% for the VCA2615
- V_{CC} = 3.3V ±10% for the CDCM7005 and ADS5272
- +0.2V – +2.5V for the V_{CNTL} voltage to the VCAs

A multiple output power supply that simultaneously enables the +5V, +3.3V and the V_{CNTL} voltage outputs works well for this platform. Otherwise, if two or more separate power supplies are used to power the platform, then the +5V supply should be turned on first to enable the TLV7733 power supervisor (U801) to provide a clean reset signal.

3 Input Signals

The input clock is applied to the SMA connector P600. The inputs are:

- Clock input for CDCM7005 or TLV3501 = –0.2V to V_{CC} + 0.2V
- Signal input for VCA2615s = –0.3V to V_{DD} + 0.3V

Eight input signals can be provided at SMA connectors P101, P102, P201, P202, P301, P302, P401 and P402. The gain control voltage (V_{CNTL}) for all eight channels is provided at the BNC connector P105.

4 Output Signals

The LVDS outputs of the ADS5272 are sent to connector J500. J500 is used to connect the demonstration platform to the ADSDeSer-50EVM in order to provide a means for deserializing the data for external processing. Test points are available for each of the VCA output channels prior to the anti-aliasing filter. Table 1 summarizes the test points and their connections to the respective output channels.

Table 1. Test Points and VCA Output Channel Connections

Test Points	VCA Output Channel
TP105/TP106	Channel 1
TP107/TP108	Channel 2
TP205/TP206	Channel 3
TP207/TP208	Channel 4
TP305/TP306	Channel 5
TP307/TP308	Channel 6
TP405/TP406	Channel 7
TP407/TP408	Channel 8

The maximum output voltage is:

- Max output voltage = V_{DD}

5 Pushbuttons and Jumpers

The demonstration platform has one pushbutton and two jumpers. Pushbutton SW800 is used to reset the system.

- SW800 connects to the TL7733B power supervisor (U801) which monitors the +3.3V power supply. When pushed, SW800 will lower the –RESET line to the MSP430F1232 (U700), which in turns resets the ADS5272 and CDCM7005 before programming the CDCM7005.
- If JP100 is removed, then the V_{CLAMP} voltage for the VCA2615s is provided externally from SMA connector P104. If JP100 is installed, then the V_{CLAMP} voltage for the VCA2615s is set using a voltage divider that is adjusted by potentiometer R120. The adjustment range on V_{CLAMP} is about 0.47V to 2.83V.
- If JP600 is installed, the CDCM7005 (U600) is disabled and the TLV3501 comparator (U601) is enabled as the clock source to the ADS5272. If JP600 is removed, the CDCM7005 is enabled as the clock source and the TLV3501 is disabled.

6 LED Indicators

There are five LED indicators on the demonstration platform.

- Power Good (D800) – This indicator is lit when a valid power is supplied to the platform and SW800 is not pressed.
- Reset (D801) – This indicator lights when the TLV7733 voltage supervisor detects a problem with the +3.3V power supply or when SW800 is pressed.
- Status_VCXO (D601) – This indicator illuminates when the CDCM7005 is enabled and the VCXO is running.
- Status_Ref (D602) – This indicator lights when a reference clock is detected on SMA connector P600.
- PLL_Lock (D603) – This indicator is lit when the PLL is locked.

7 VCA Configuration Switches

There are two banks of DIP switches on the demonstration platform that are used to configure each VCA2615. Please consult the VCA2615 datasheet for a complete description of these configuration options. Table 2 lists the default switch settings.

Table 2. DIP Switch Default Settings

SWx00 Position	Default Setting	Description	SWx01 Position	Default Setting	Description
1	Off (+5V)	LNP Gain 1	1	On (GND)	VCA In Select
2	Off (+5V)	LNP Gain 2	2	Off (+5V)	FB Sel 4
3	Off (+5V)	LNA PD	3	On (GND)	FB Sel 3
4	Off (+5V)	VCA PD	4	On (GND)	FB Sel 2
5	Off (+5V)	VCA –H/L Gain	5	On (GND)	FB Sel 1

8 Operation

This section provides detailed instructions on how to run a single channel of the demonstration platform with the default jumper and switch settings and the ADSDeSer-50EVM board attached to deserialize the ADC outputs.

- Connect the ADSDeSer-50EVM to the demonstration platform via connector J500.
- Connect the +5V and +3.3V power supplies to the appropriately labeled power jacks on the demonstration platform.
- Connect the +3.3V power supply to the ADSDeSer-50EVM board. (This supply can be the same power supply used to power the demonstration platform.)
- Connect a power supply that has been adjusted to 1.4V to the V_{CNTL} voltage BNC connect P105.
- Turn on the power supplies and make sure that the *POWER GOOD* LED lights.
- Connect a clock source of 65MHz with amplitude of 4dBm to SMA connector P600. Make sure that jumper JP600 is not installed. The *Status_Ref* and *PLL_Lock* LEDs should light.
- Connect an input signal of 5MHz (5,000,763Hz) with amplitude of -15.9dBm to SMA connector P101.
- Check that jumper JP100 is installed. Adjust potentiometer R120 until the V_{CLAMP} voltage is 2.8V. The V_{CLAMP} voltage can be measured on pin 2 of JP100 or at the SMA connector P104.
- Use an oscilloscope to verify the input signal amplitude is about $100mV_{PP}$. Use a differential probe to look at test points TP105/TP106 to verify that the VCA output is not clipping. If the output is clipping, reduce the input signal or adjust V_{CNTL} to remove the clipping. Use a differential probe to look at the output of the anti-aliasing filter across R114.
- Connect a logic analyzer to channel 1 of the ADSDeSer-50EVM and push the reset button on the deserializer board. Observe the 12-bit ADC outputs on the logic analyzer.

9 Serial Port

The ADS5272 registers can be changed by connecting a serial cable between a PC and the demonstration platform through the DB9 connector J700. The ADS527x EVM software can be installed on the PC and used to program the ADS5272 registers. These registers can be used to enable test modes, program LVDS drive currents, enable/disable channels and set up the LSB/MSB configuration.

10 Physical Description

This section describes the physical characteristics and PCB layout of the demonstration platform, and lists the components used in the platform as well.

10.1 Schematics

Figure 1 through Figure 9 show the schematics of the demonstration platform.

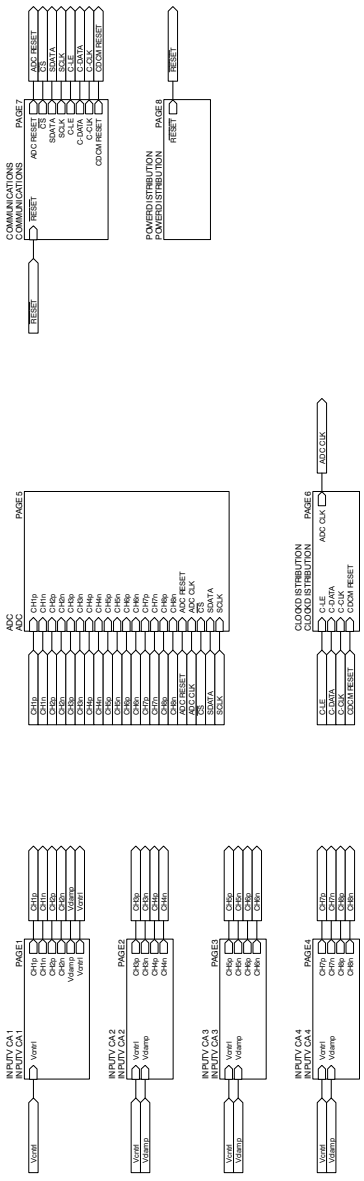

Figure 1. Connection Diagram

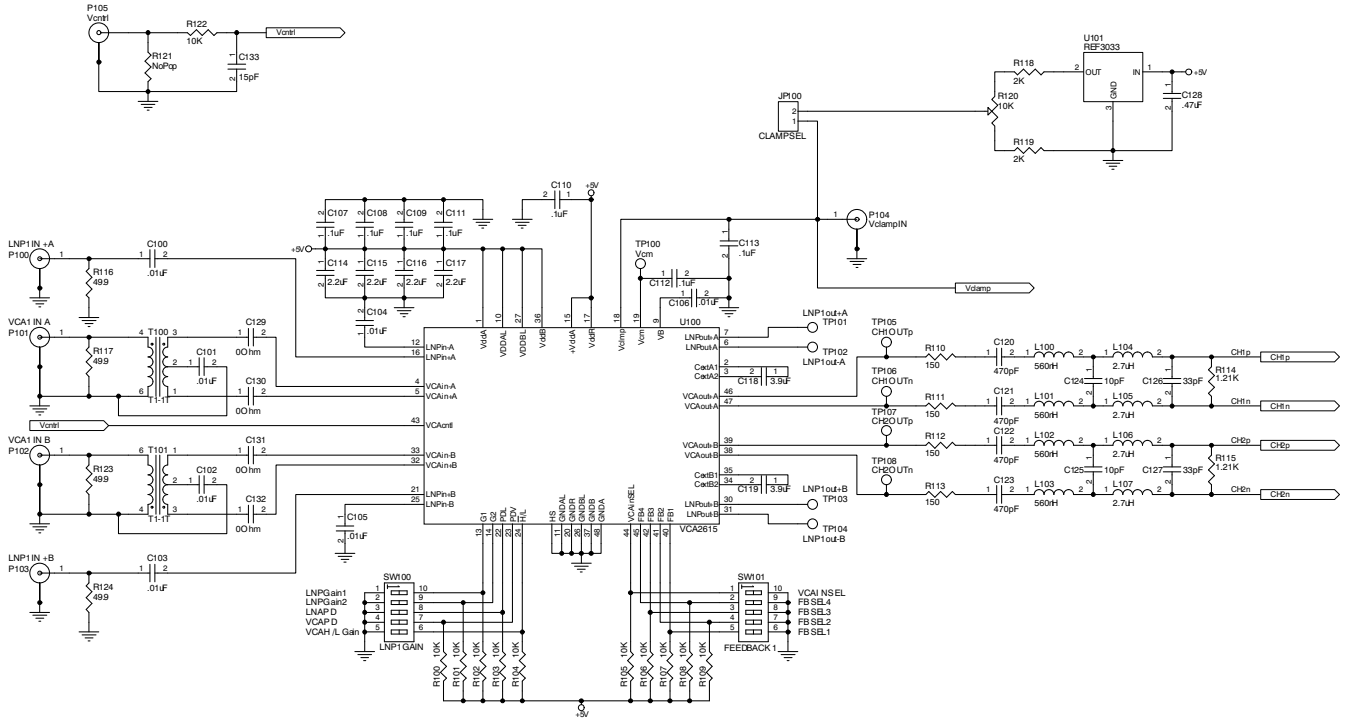

Figure 2. Demonstration Platform—Input VCA1 Section

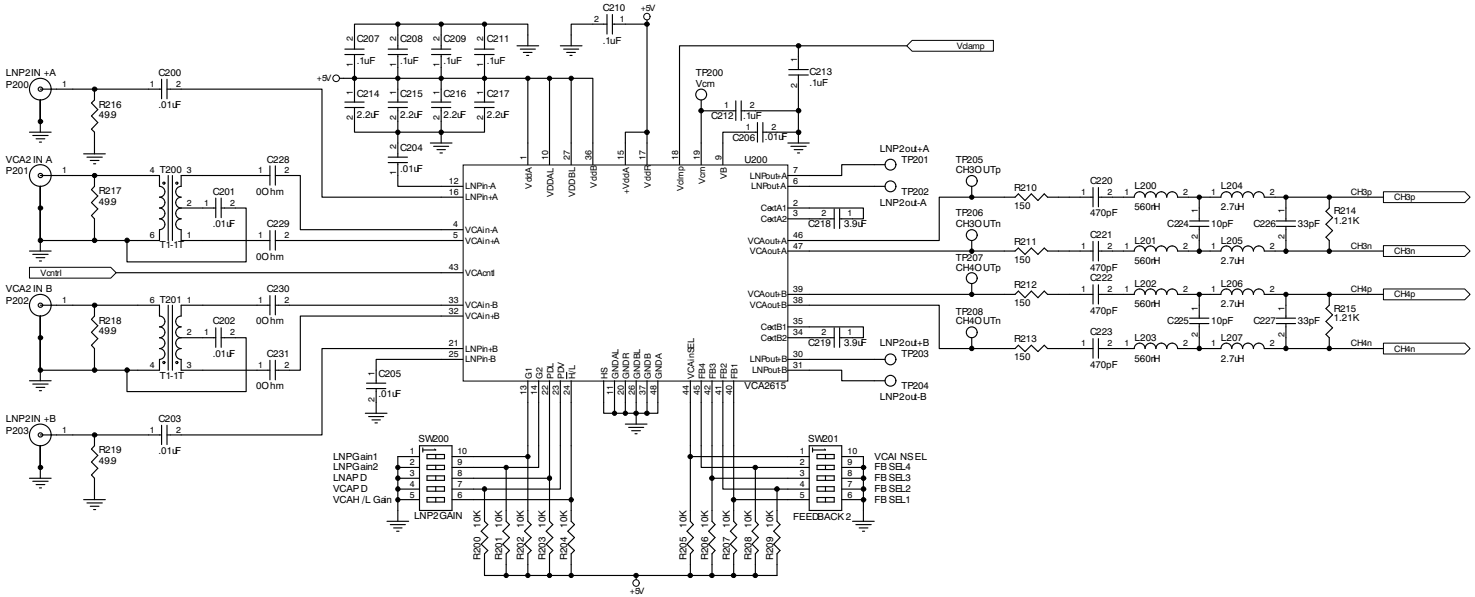

Figure 3. Demonstration Platform—Input VCA2 Section

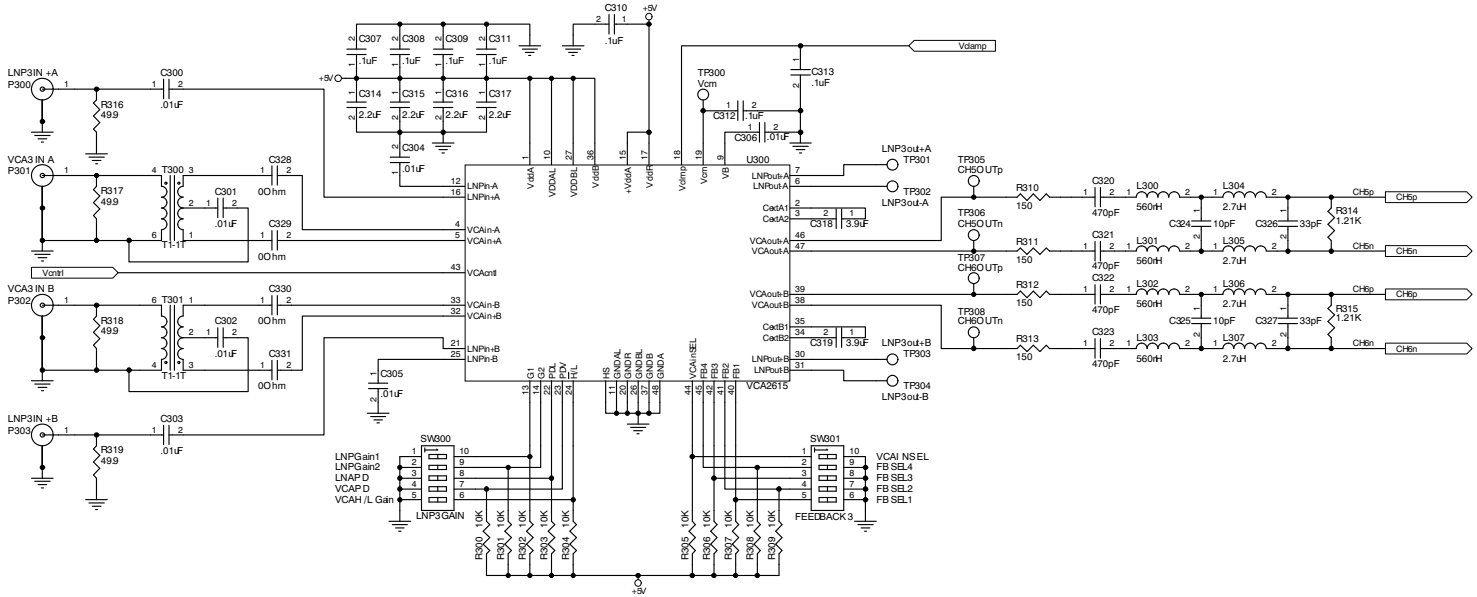

Figure 4. Demonstration Platform—Input VCA3 Section

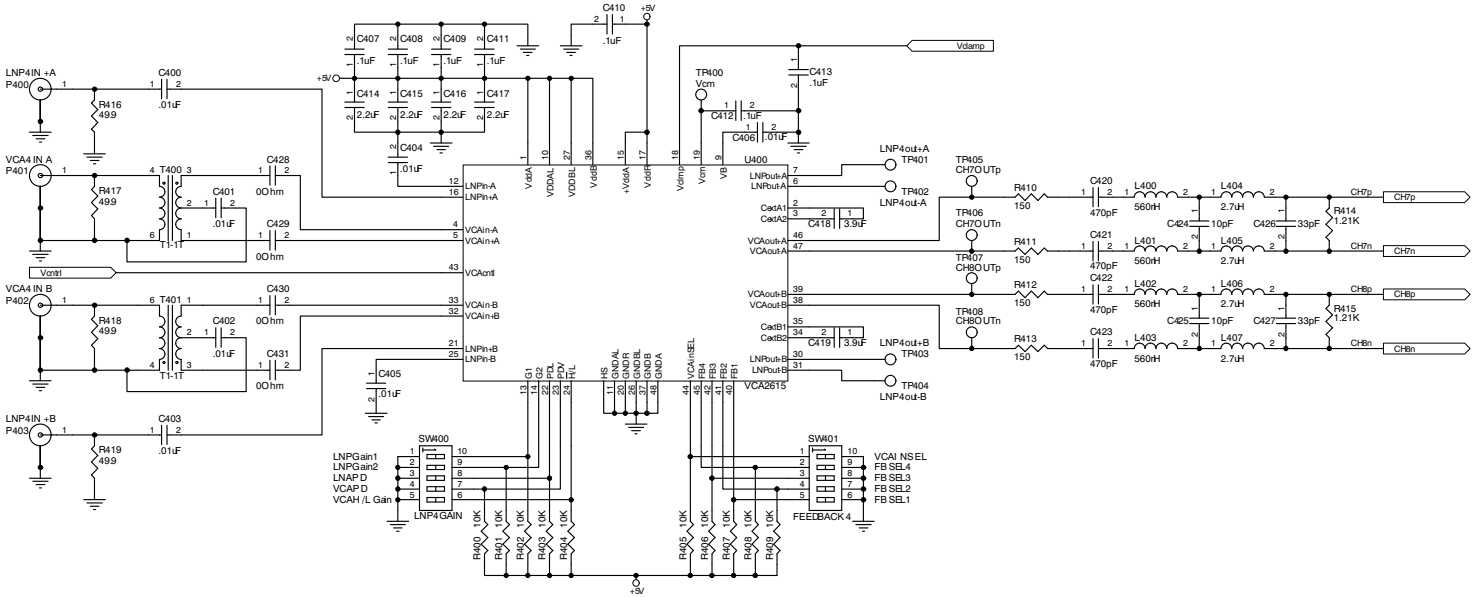

Figure 5. Demonstration Platform—Input VCA4 Section

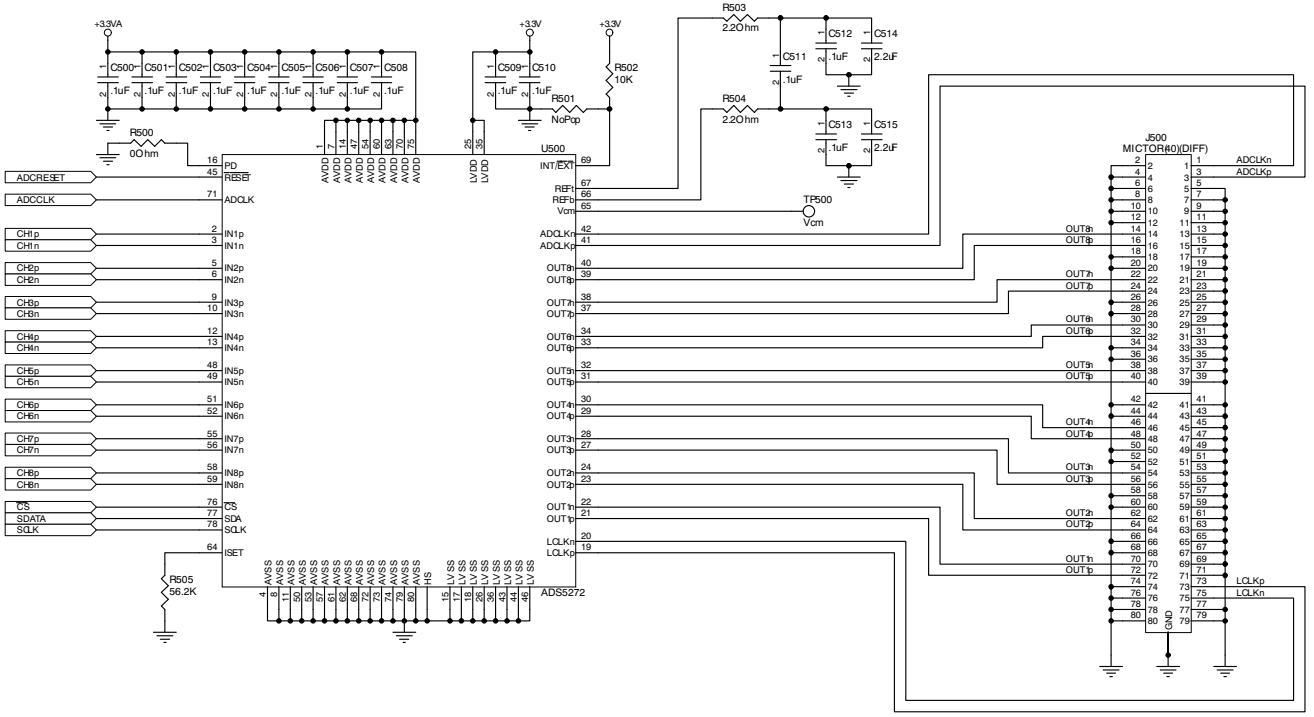

Figure 6. Demonstration Platform—ADC Section

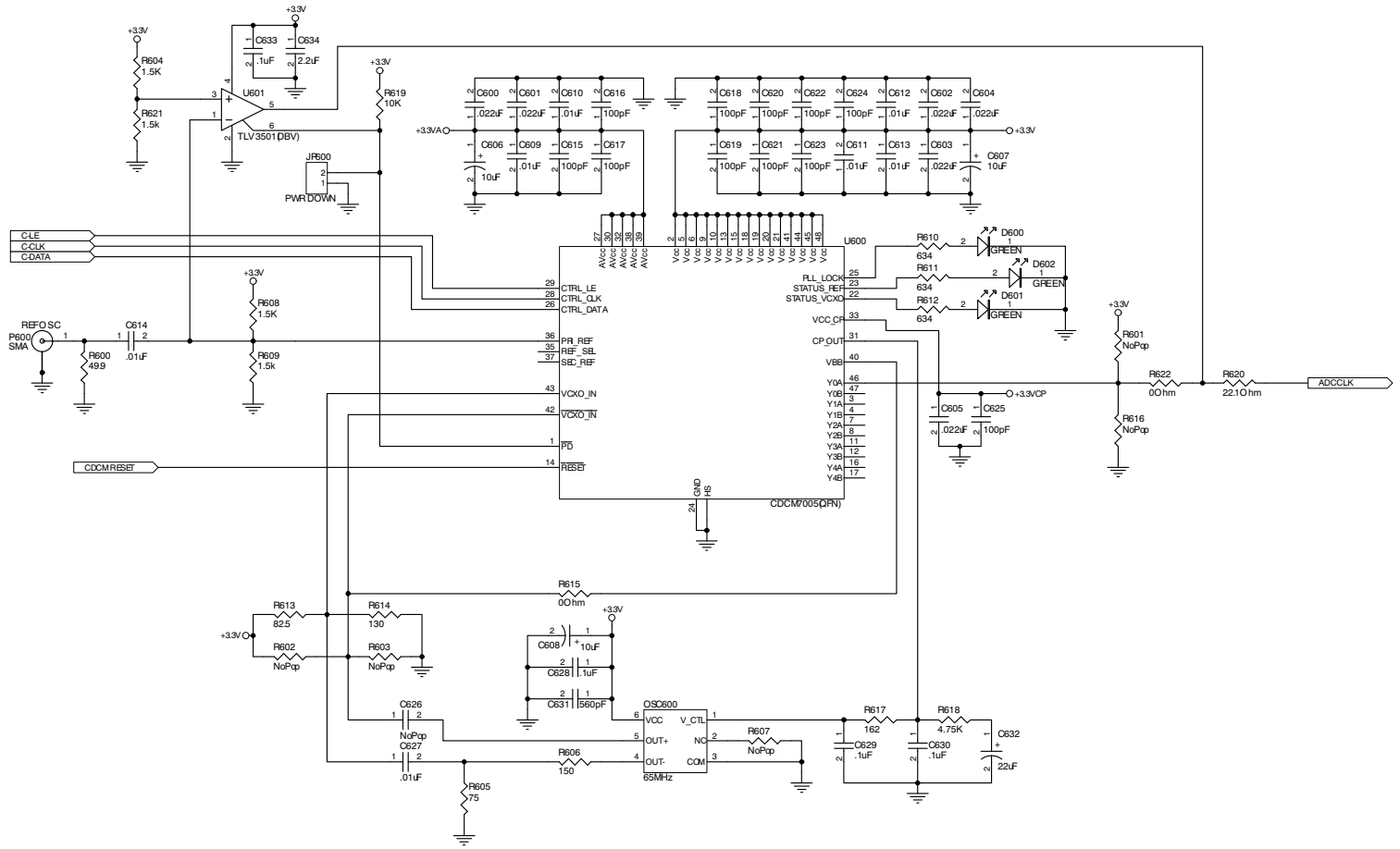

Figure 7. Demonstration Platform—Clock Distribution Section

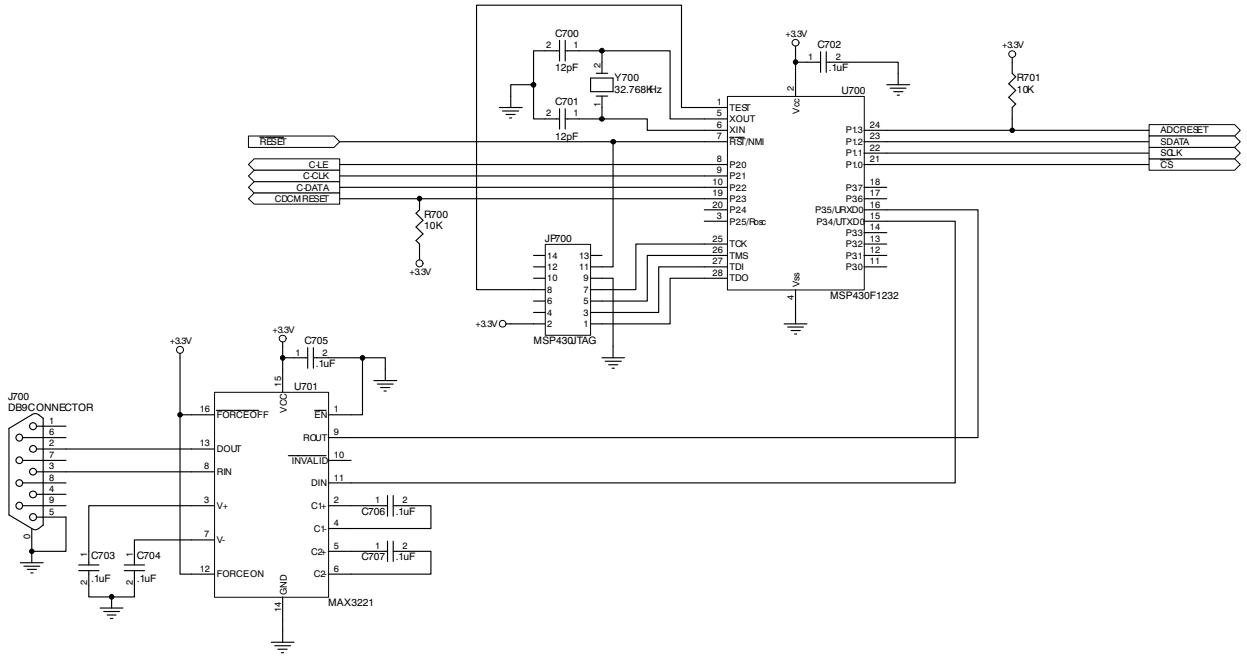

Figure 8. Demonstration Platform—Communications Section

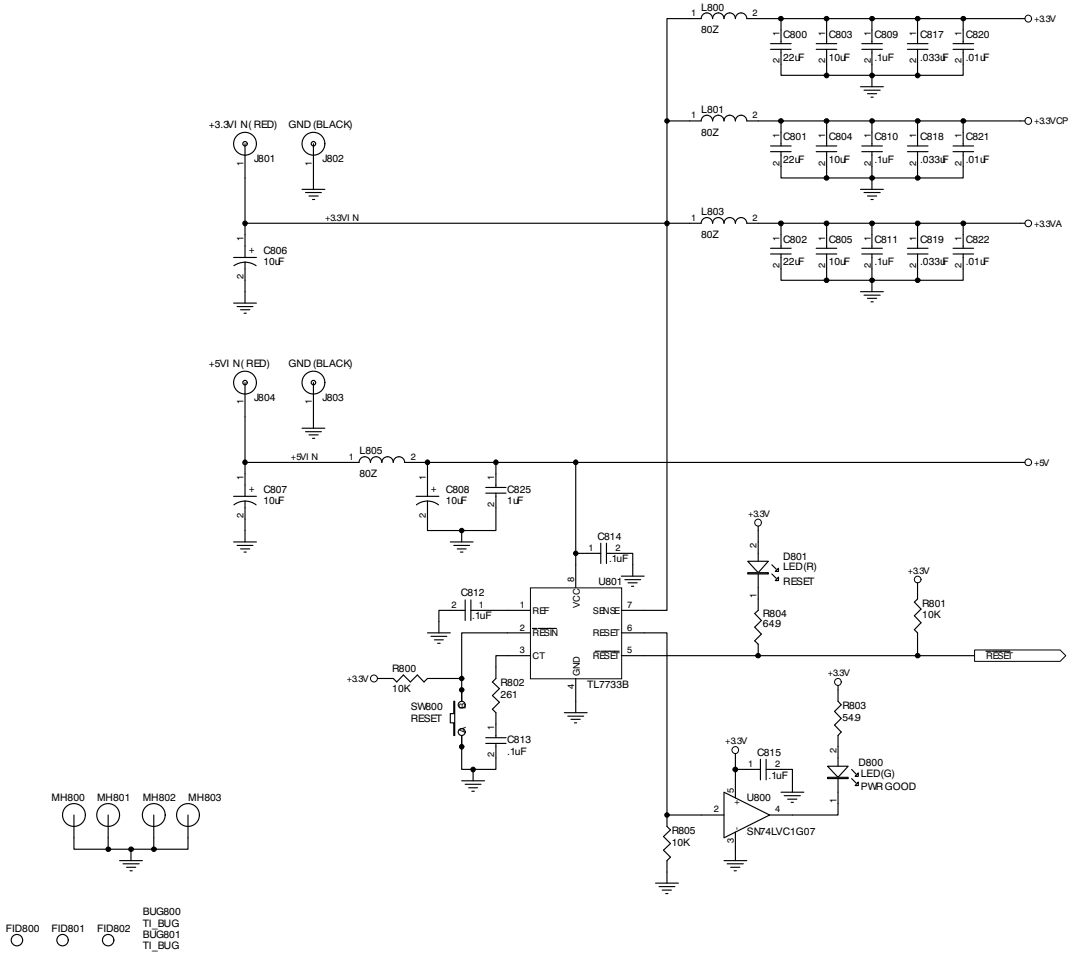

Figure 9. Demonstration Platform—Power Distribution Section

10.2 PCB Layout

A brief description of the individual PCB layers is given in Figure 10 through Figure 14. Note that these drawings are not to scale; they are provided for reference only.

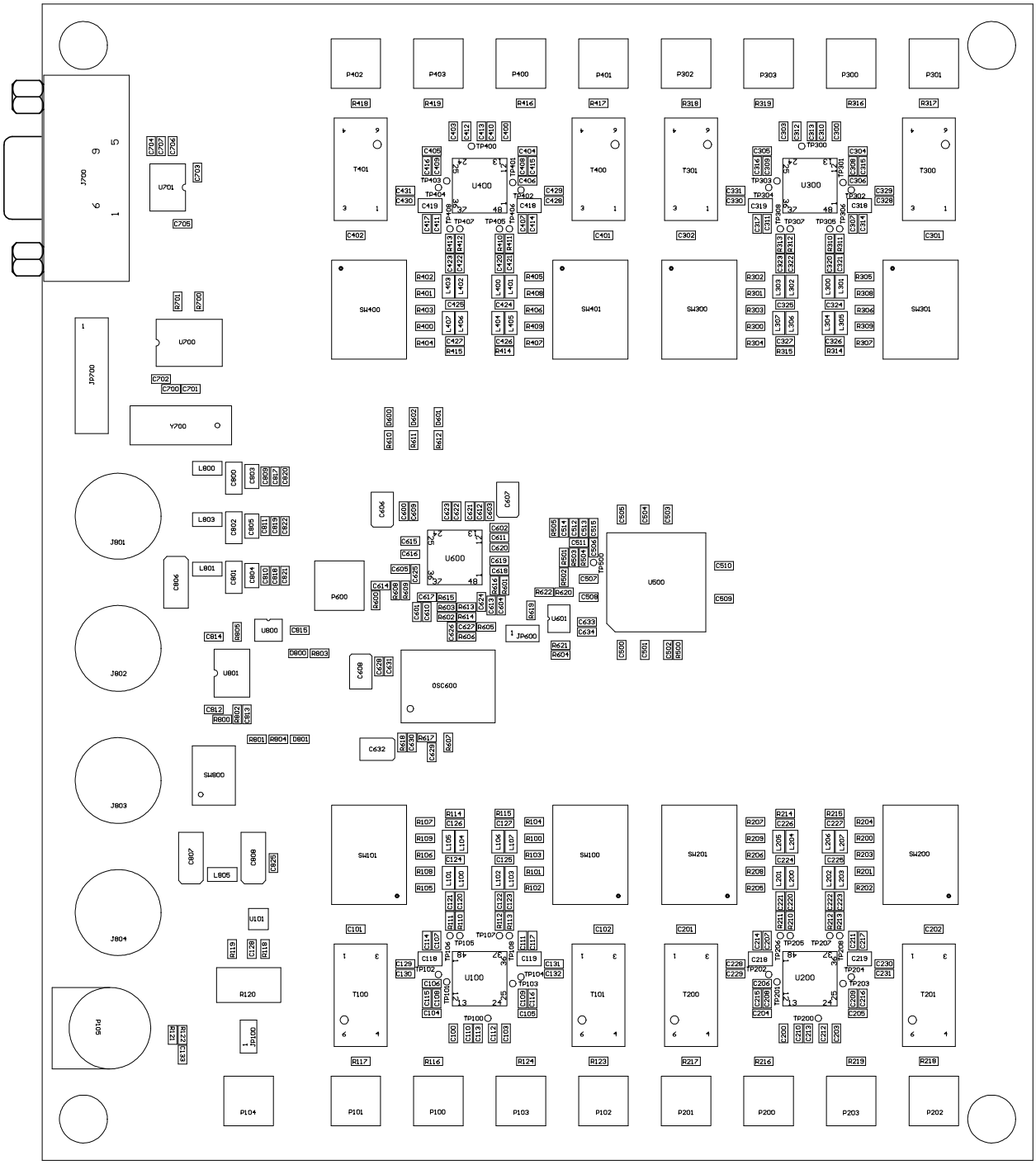

Figure 10. Demonstration Platform PCB Assembly (Top Layer)

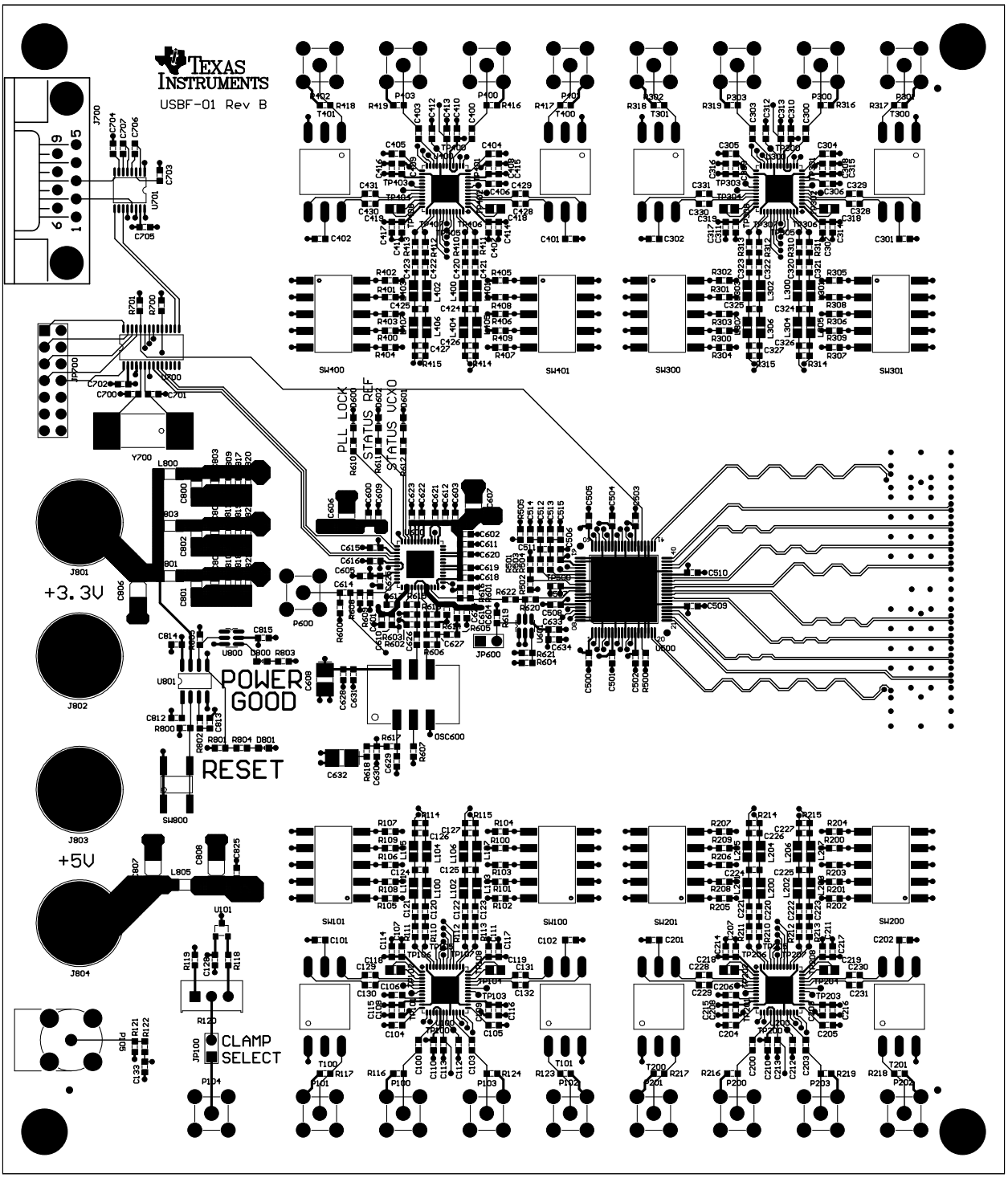

Figure 11. Demonstration Platform PCB—Top Layer

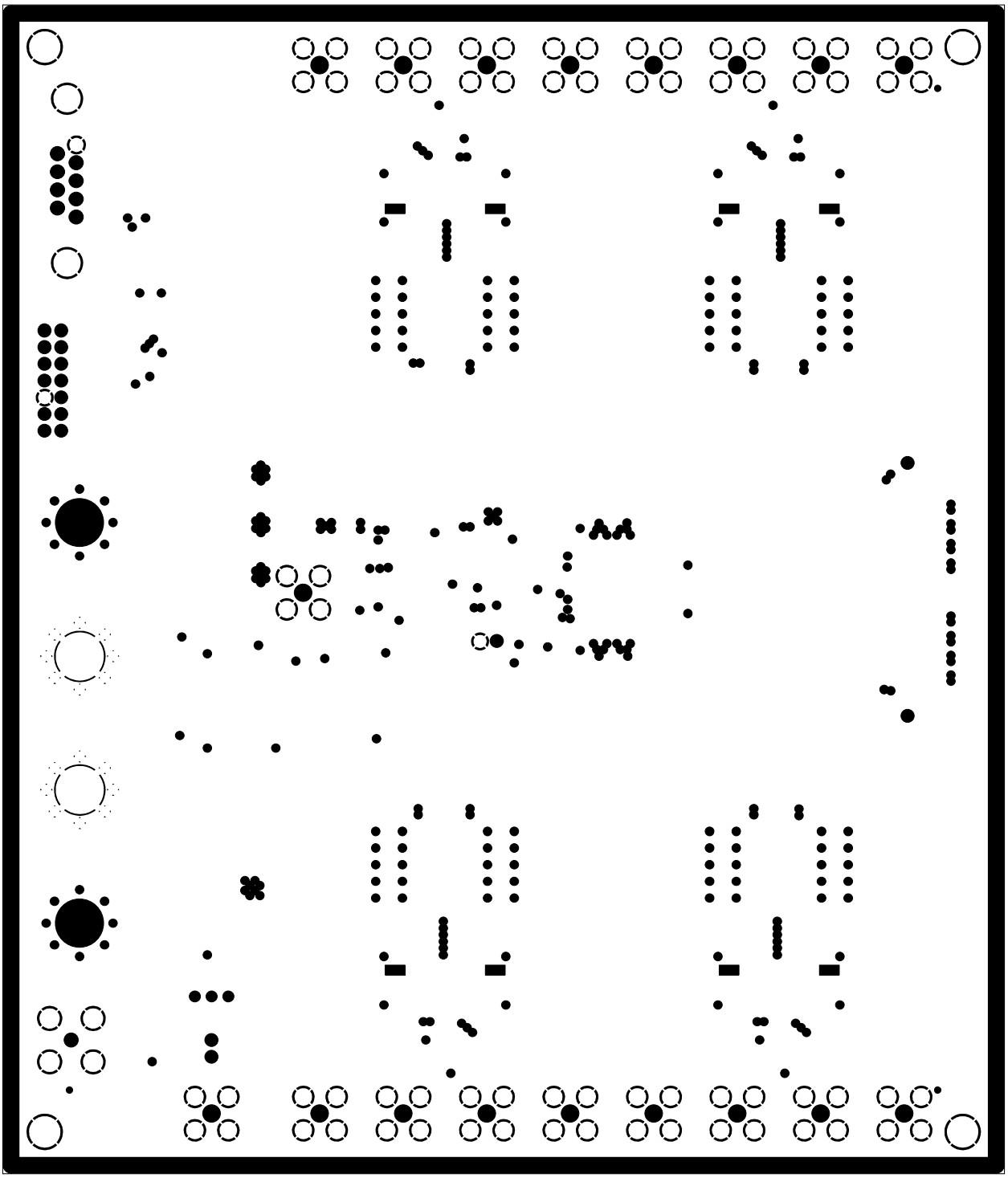

Figure 12. Demonstration Platform PCB—Ground Layer

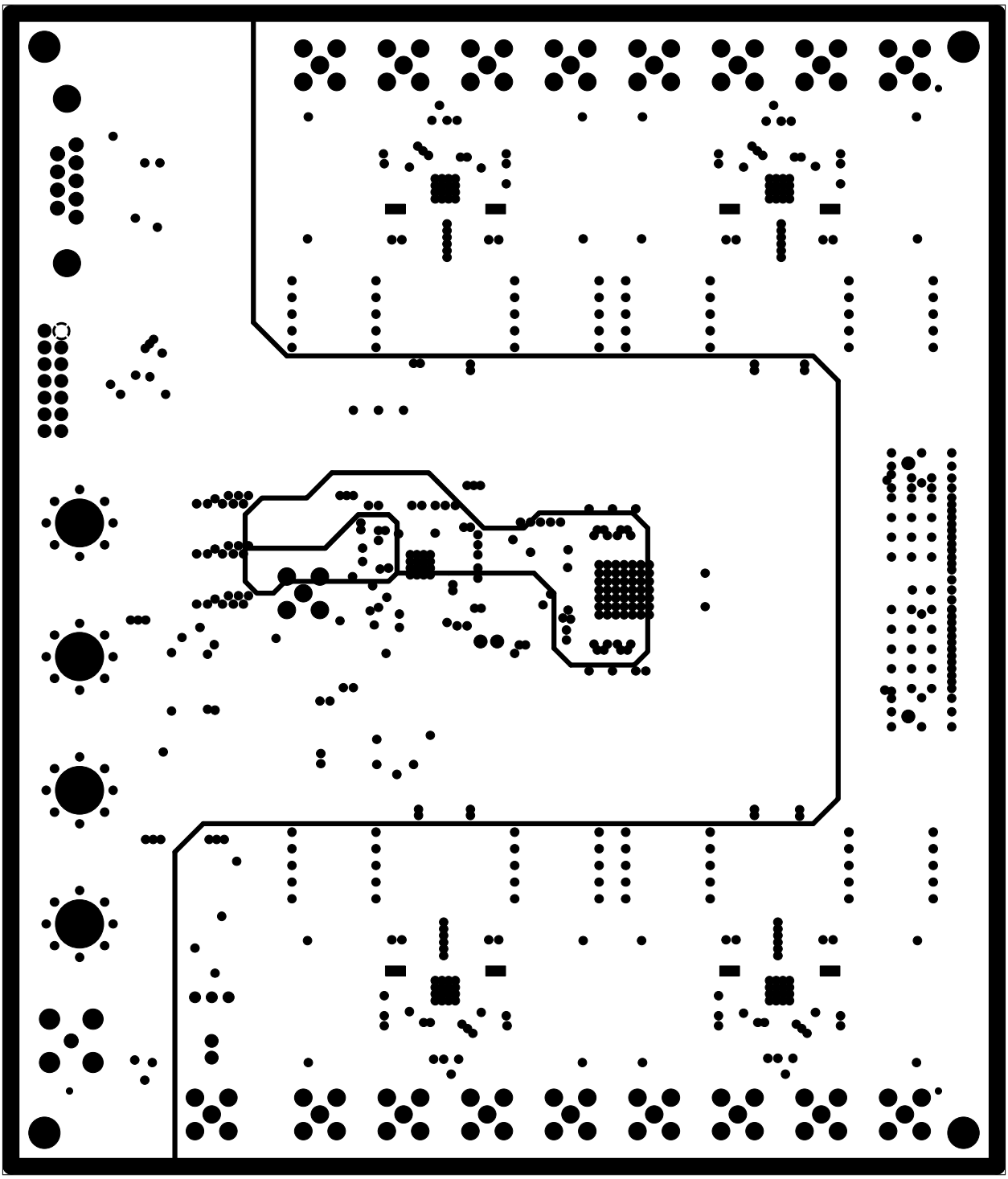

Figure 13. Demonstration Platform PCB—Power Layer

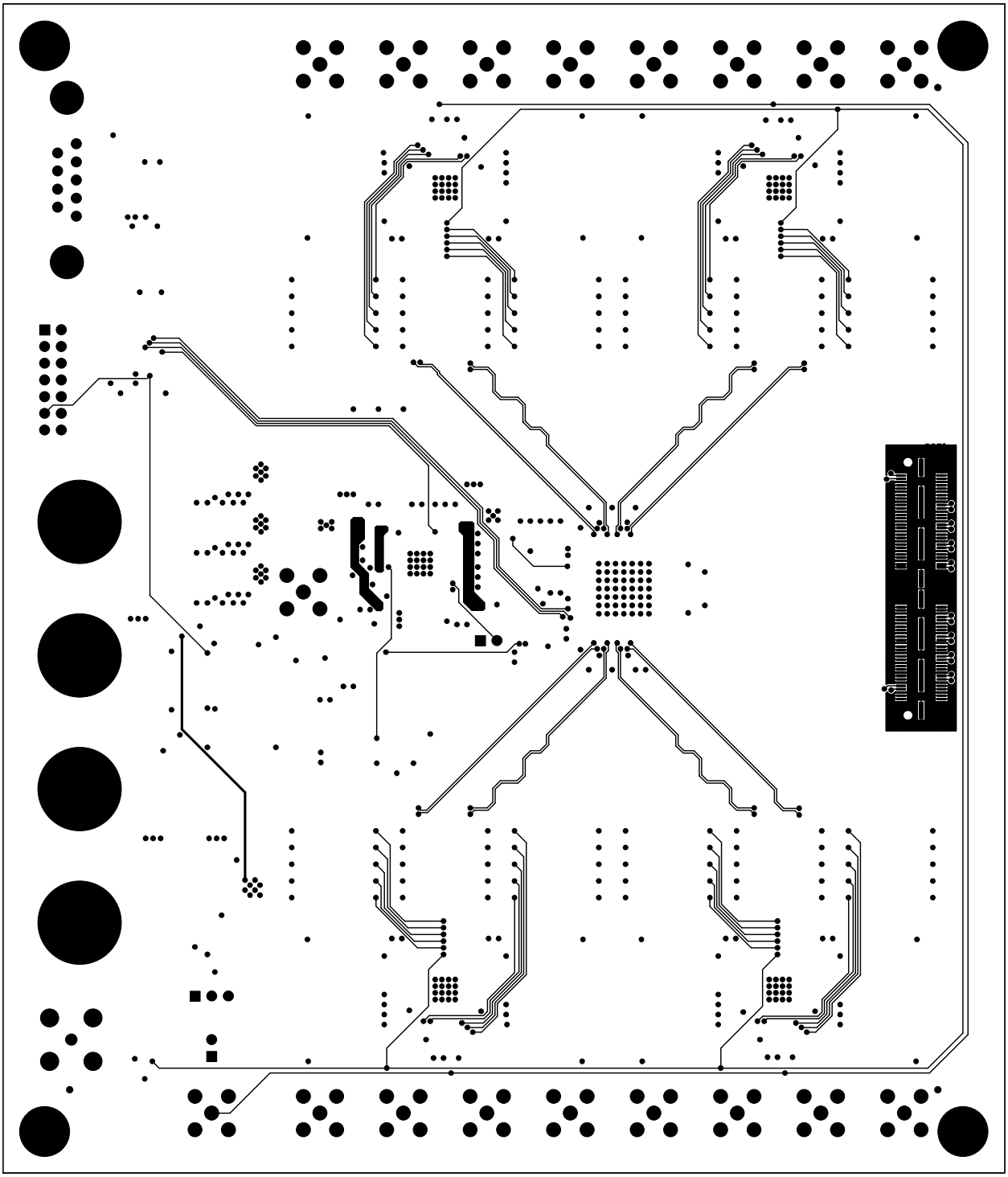

Figure 14. Demonstration Platform PCB—Bottom Layer

10.3 Parts List

The Parts List, showing the components used in the assembly of the demonstration platform, is given in Table 3.

Table 3. Ultrasound Receive Chain Demonstration Platform Parts List

ITEM	TI PART NUMBER	PART TYPE	REFERENCE DESIGNATOR	FOOTPRINT	MFR PART NUMBER	MFR	QTY PER BOARD
1	TIR03J0000R0	0Ω	C129-C132, C228-C231, C328-C331, C428-C431	CAP_0603	ERJ3GEY0R00V	Panasonic	16
2	TIC03NP50100	10pF	C124, C125, C224, C225, C324, C325, C424, C425	CAP_0603	ECJ1VC1H100D	Panasonic	8
3	TIC03NP50120	12pF	C700, C701	CAP_0603	ECJ1VC1H120J	Panasonic	2
4	TIC03NP50150	15pF	C133	CAP_0603	ECJ1VC1H150J	Panasonic	1
5	TIC03NP50330	33pF	C126, C127, C226, C227, C326, C327, C426, C427	CAP_0603	ECJ1VC1H330J	Panasonic	8
6	TIC03NP50101	100pF	C615-C625	CAP_0603	ECJ1VC1H101J	Panasonic	11
7	TIC03NP50471	470pF	C120-C123, C220-C223, C320-C323, C420-C423	CAP_0603	ECJ1VC1H471J	Panasonic	16
8	TIC03NP50561	560pF	C631	CAP_0603	ECJ1VC1H561J	Panasonic	1
9	TIC03X750103	.01µF	C100-C106, C200-C206, C300-C306, C400-C406, C609-C614, C627, C820-C822	CAP_0603	ECJ1VB1H103K	Panasonic	38
10	TIC03X750223	.022µF	C600-C605	CAP_0603	ECJ1VB1H223K	Panasonic	6
11	TIC03X750333	.033µF	C817-C819	CAP_0603	ECJ1VB1H333K	Panasonic	3
12	TIC03X716104	.1µF	C107-C113, C207-C213, C307-C313, C407-C413, C500-C513, C62	CAP_0603	ECJ1VB1C104K	Panasonic	59
13	TIC03Y516474	.47µF	C128	CAP_0603	ECJ1VF1C474Z	Panasonic	1
14	TIC03X510105	1µF	C825	CAP_0603	ECJ1VB1A105K	Panasonic	1
15	TIC03Y510225	2.2µF	C114-C117, C214-C217, C314-C317, C414-C417, C514, C515, C634	CAP_0603	GRM188F51A225ZE01D	Murata	19
16	TIC05X710395	3.9µF	C118, C119, C218, C219, C318, C319, C418, C419,	CAP_0805	C0805C395K8PACTU	Kemet	8
17	TIC05X510106	10µF	C803-C805	CAP_0805	GRM21BR61A106KE19L	Murata	3
18	TICTB1016106	10µF	C606-C608	CAP_TANT-B	T491B106K016AS	Kemet	3
19	TICTC1020106	10µF	C806-C808	CAP_TANT-C	T491C106K020AS	Kemet	3
20	TIC06X516226	22µF	C800-C802	CAP_1206	ECJ3YB1A226M	Panasonic	3
21	TICTB1016226	22µF	C632	CAP_TANT-B	TAJB226K016R	AVX	1
22	TIJD02000000	DB9 Connector	J700	CONNECTOR DB9F-RA	182-009-212-531	NorComp	1
23	TIJJ02100001	V_{CNTRL}	P105	BNC (AMP-RA)	413631-1	AMP	1

Table 3. Ultrasound Receive Chain Demonstration Platform Parts List (continued)

ITEM	TI PART NUMBER	PART TYPE	REFERENCE DESIGNATOR	FOOTPRINT	MFR PART NUMBER	MFR	QTY PER BOARD
24	TIJJ01000001	V_{CLAMP} IN	P100, P103, P200, P203, P300, P303, P400, P403, P600, P101, P102, P201, P202, P301, P302, P401, P402, P104	SMA	901-144-8RFX	Amphenol	18
25	TIJH41102000	PWR DOWN	JP100, JP600	HEADER 2x1(PTH)	PZC02SAAN	Sullins	2
26	TIJH41207000	MSP430 JTAG	JP700	HEADER 7x2(PTH)	PZC07DAAN	Sullins	1
27	TIJP33240000	MICTOR(40) (DIFF)	J500	MICTOR (SAM-QTH)(40)	QTH-040-01-L-D-DP-A	Samtec	1
28	TIJJ01000002	+5V IN (RED)	J801, J804	BANANA JACK	ST-351A	Alectron	2
29	TIJJ01000003	GND (BLACK)	J802, J803	BANANA JACK	ST-351B	Alectron	2
30	TIOCS0000002	32.768kHz	Y700	CRYSTAL (MA-505)	MC-405 32.768K-A0	Epson	1
31	TIDS00000005	LED (Green)	D600-D602, D800	LED (SMT0603)	SML-LX0603GW-TR	Lumex	4
32	TIDS00000006	LED (Red)	D801	LED (SMT0603)	SML-LX0603IW-TR	Lumex	1
33	TIU100000152	ADS5272	U500	HTQFP (80) (PFP)	ADS5272IPFP	Texas Instruments	1
34	TIU100000153	CDCM7005 (QFN)	U600	QFN (48) (RGZ)	CDCM7005RGZ	Texas Instruments	1
35	TIU100000037	MAX3221	U701	TSSOP (16) (PW)	MAX3221IPW	Texas Instruments	1
36	TIU100000154	MSP430F1232	U700	TSSOP (28) (PW)	MSP430F1232IPW	Texas Instruments	1
37	TIU100000086	REF3033	U101	SOT23	REF3033AIDBZT	Texas Instruments	1
38	TIU100000177	SN74LVC1G07	U800	SOT23 (6) (DBV)	SN74LVC1G07DBVT	Texas Instruments	1
39	TIU100000158	TL7733B	U801	SOIC (8) (D)	TL7733BCD	Texas Instruments	1
40	TIU100000178	TLV3501 (DBV)	U601	SOT23 (6) (DBV)	TLV3501AIDBVT	Texas Instruments	1
41	TIU100000159	VCA2615	U100, U200, U300, U400	QFN (48) (RGZ)	VCA2615RGZ	Texas Instruments	4
42	TILI05000R56	560nH	L100-L103, L200-L203, L300-L303, L400-L403	IND_0805	ELJNDR56JF	Panasonic	16
43	TILI050002R7	2.7µH	L104-L107, L204-L207, L304-L307, L404-L407	IND_0805	ELJFD2R7KF	Panasonic	16
44	TILB06000080	80Z	L800, L801, L803, L805	BEAD_1206	HI1206N800R-00	Steward	4
45	TIOOS0000009	65MHz	OSC600	OSC (TOYO-TCO-211X)	TCO-2107H1-65.00MHz	Toyocom	1
46	TIRPOT0H1002	10k	R120	POT (BOURNS 3296W)	3296W-1-103	Bourns	1
47	TIR03J0000R0	0Ω	R500, R615, R622	RES_0603	ERJ3GEY0R00V	Panasonic	3
48	TIR03F0002R2	2.2Ω	R503, R504	RES_0603	ERJ3RQF2R2V	Panasonic	2
49	TIR03F0022R1	22.1Ω	R620	RES_0603	ERJ3EKF22R1V	Panasonic	1

Table 3. Ultrasound Receive Chain Demonstration Platform Parts List (continued)

ITEM	TI PART NUMBER	PART TYPE	REFERENCE DESIGNATOR	FOOTPRINT	MFR PART NUMBER	MFR	QTY PER BOARD
50	TIR03F0049R9	49.9Ω	R116, R117, R123, R124, R216-R219, R316-R319, R416-R419, R600	RES_0603	ERJ3EKF49R9V	Panasonic	17
51	TIR03F0054R9	54.9Ω	R803	RES_0603	ERJ3EKF54R9V	Panasonic	1
52	TIR03F0064R9	64.9Ω	R804	RES_0603	ERJ3EKF64R9V	Panasonic	1
53	TIR03F0075R0	75Ω	R605	RES_0603	ERJ3EKF75R0V	Panasonic	1
54	TIR03F0082R5	82.5Ω	R613	RES_0603	ERJ3EKF82R5V	Panasonic	1
55	TIR03F001300	130Ω	R614	RES_0603	ERJ3EKF1300V	Panasonic	1
56	TIR03F001500	150Ω	R110-R113, R210-R213, R310-R313, R410-R413, R606	RES_0603	ERJ3EKF1500V	Panasonic	17
57	TIR03F001620	162Ω	R617	RES_0603	ERJ3EKF1620V	Panasonic	1
58	TIR03F002610	261Ω	R802	RES_0603	ERJ3EKF2610V	Panasonic	1
59	TIR03F006340	634Ω	R610-R612	RES_0603	ERJ3EKF6340V	Panasonic	3
60	TIR03F001211	1.21kΩ	R114, R115, R214, R215, R314, R315, R414, R415	RES_0603	ERJ3EKF1211V	Panasonic	8
61	TIR03F001501	1.5kΩ	R604, R608, R609, R621	RES_0603	ERJ3EKF1501V	Panasonic	4
62	TIR03F002001	2kΩ	R118, R119	RES_0603	ERJ3EKF2001V	Panasonic	2
63	TIR03F004752	4.75kΩ	R618	RES_0603	ERJ3EKF4752V	Panasonic	1
64	TIR03F001002	10kΩ	R100-R109, R122, R200-R209, R300-R309, R400-R409, R502, R61	RES_0603	ERJ3EKF1002V	Panasonic	48
65	TIR03F005622	56.2kΩ	R505	RES_0603	ERJ3EKF5622V	Panasonic	1
66	TIS11S050000	LNP4 GAIN	SW101, SW201, SW301, SW401, SW100, SW200, SW300, SW400	DIPSW (SMT-5)	219-5MST	CTS	8
67	TIS11S010000	RESET	SW800	SWITCH (ITT-KSC-J)	KSC221J	ITT Canon	1
68	TILT00000008	T1-1T	T100, T101, T200, T201, T300, T301, T400, T401	XFMR (MINI-KK81-EV)	T1-1T-KK81	Minicircuits	8

EVALUATION BOARD/KIT IMPORTANT NOTICE

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This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 3.3V ±10% and the output voltage range of 5V ±10%.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than +60°C. The EVM is designed to operate properly with certain components above +60°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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